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Virtual Laboratory Environment In Earth And Space: An Assessment On Students' Learning Achievement And Attitude

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Abstract

Science is one of the most important academic disciplines, and it covers an extensive variety of subjects. It makes improvement and makes our day-to-day living more comfortable. On these challenging times encountered by education, not only in the Philippines but globally, DepEd continues to strive giving quality education for all. Efforts are put into action until it achieves the quality of education. Methods and techniques of teaching were improved, particularly the use of Virtual Laboratory for science subjects. Even on an online setting, it helps developing student's laboratory skills. The researcher focuses on applying virtual laboratory environment in Earth and Space Science lessons to make the subject more interesting and informative to learn. It is now possible to virtually observe and hear different natural phenomena through simulations and other forms of virtual laboratories. The study focused on assessing students' learning achievement and attitude in Earth and Space on a virtual laboratory environment with the purpose to encourage the application of advance technology for better student learning experience and learning performance. The study aims to improve student's' learning achievement and develop learning attitude towards science. Integrating a virtual laboratory enables enhanced knowledge and skills to be acquired actively.

The study utilized a convergent parallelism mixed method. For the quantitative method of the study, the researcher chose quasi-experimental research designs with a post-test focus and descriptive research design for qualitative research design. Accordingly, the study assesses Students' Learning Achievement and Attitude in Earth and Space on a Virtual Laboratory Environment, thru: (a) Science Skills, (b) Science Understanding, (c) Science Quarterly Grade (d) Student Participation, (e) Student attitude to learn science. These reveal the changes on Students' Learning Achievement and Attitude in Earth and Space on a Virtual Laboratory Environment. The intervention supports student achievement amid low motivation in online class, it helps

students be conscious in the application of their science skills, be more focused-learning, improve their confidence, and helps them enjoy learning. The coded perceived changes on students are believed to be the same changes towards other people.

Keywords: *Earth and space, learning achievement, learning attitude, science, virtual laboratory*

Introduction

Student attainment has become an essential topic in Education today, especially with greater accountability for classroom educators. It is considered one of the significant goals for teachers to make sure that students will improve their skills and abilities to be ready for the future. There will be a more significant improvement in student achievement with quality instruction and standards (Carter, 2021).

Moreover, student attitude is another important factor in improving learning. Student learning attitude is lasting and consistent with an individual's cognition and emotions. The three domains of students—cognitive, affective, and psychomotor—are concepts affecting student emotions, attitudes, and things related to the learning process, such as their behavior towards learning. According to Heather Dautrich from Good Grades Tutoring Center (2021), a positive Attitude plays a critical role in learning anything. If learners have a positive outlook, it will make the learner more receptive to new ideas and thoughts. A positive attitude will make it easier to learn new things.

Education after the COVID-19 pandemic has worsened. The Department of Education tried to find a solution to the current situation. To continue Education, every school adjusted and used online learning in exchange for the absence of face-to-face learning. Public and private schools are affected by the pandemic. Students who no longer attend school are found to have poor reading proficiency, based on UNESCO's estimated more than 100 million children. The Department of Education has recognized these results and viewed them as a way to identify the gaps that should be resolved. It considers a way to improve the curriculum and take action to address learning gaps (Baclig, 2020).

Today, Education adopts online learning. The unexpected change from traditional learning to 100% online learning affects students' learning effectiveness (Hong et al., 2021). COVID-19, the recent pandemic, brought uncertainty in educational facets among educators. The situation led to the use of virtual laboratories, though this already existed even before the pandemic started. It proves that virtual laboratories have transformed teaching laboratory courses. Virtual Laboratory serves as a platform to train students to develop their understanding and skills of the nature of Science being taught, especially during the pandemic (Radhamani et al., 2021).

There are different types of virtual laboratories, which include various applications and serve different purposes. Virtual labs are not limited to a single technique. As a pedagogical technique, especially for online learning, learners experience a different level of laboratory use. Students are allowed to conduct experiments without any risk. Through these, students learn and understand scientific theories better. It covers different categories, such as simulations and VR

spaces. Virtual laboratories are very easy to access. Different platforms offer free access whenever students want to learn. It is now easier for students to open these laboratories through their own devices from any location, making them indispensable for contactless learning. (Hurix, 2021)

LabXchange, NOVA, Phet, Science Buddies, eduMedia, and Gizmos are some of the known virtual laboratories. For generations, the Laboratory has been considered one of the most effective ways of learning and teaching. The COVID-19 pandemic challenges the old way of using it and requires a new design that will be more appropriate to the situation. Now, people and organizations all over the world have had to adjust to new ways of work and life (Rahul et al., 2020)

Other branches of Science are known for using laboratories, most commonly for biology, chemistry, and physics, but they are very uncommon in Earth and Space during face-to-face classes. All are equally important. With that, to explore Earth and space more, the study focuses on this field. It is one of the rarely used virtual laboratories in Science. Earth and space science focus on the Earth and its place within the solar system and universe, which, in reality, is impossible to visit. Also, it includes the study of the Earth in general. It includes the water cycle, the carbon cycle, the rock cycle, and anything that gradually affects the Earth over time. (Wood, D. 2020). The researcher focuses on applying virtual laboratory environments in Earth and Space Science lessons to make the subject more exciting and informative. It is now possible to virtually observe and hear different natural phenomena through simulations and other forms of virtual laboratories.

Objective of the study

Having mentioned the above statements, the study will focus on assessing students' learning achievement and attitude toward Earth and Space in a virtual laboratory environment to encourage the application of advanced technology for a better student learning experience and learning performance. The study aims to improve students' learning achievement and develop learning attitudes towards science.

Statement of the Problem

The study aimed to determine the perceived changes on Students' Learning Achievement and Attitude in Earth and Space on a Virtual Laboratory Environment during SY 2021-2022. Specifically, the study sought answers questions; how may the following student-related factors be described in terms of their science skills, science understanding, and learning attitude (Student participation, recitation, and task submission)?, how may the student's learning performance be described before and after the use of the Virtual Laboratory?, how may the Virtual Laboratory be described in terms of its accessibility, content, and topic relevance?, is there a significant difference in the learning performance of the students before and after the application of the Virtual Laboratory?, and what are the perceived changes in the learning attitude of the students after the intervention?

Methodology

Research Design

The study utilized a convergent parallelism mixed method. For the quantitative method of the study, the researcher chose quasi-experimental research designs with a one-group post-test focus and descriptive research design for qualitative research design. Quasi-experimental research resembles experimental research but is not accurate experimental research. The researcher did not randomly assign participants to conditions or orders of conditions while manipulating the independent variable.

The research design used a Virtual Laboratory intervention. The intervention consists of simulation, games, and analysis using Volcano Lab, UCAR Games and Simulations, and Solar System Scope Simulator. The third Quarter focuses on Earth and Space Science.

Population and Sample of the Study

The population of the study includes six sections from Grade 9 Department of Tomas Del Rosario College. Three of the six sections were randomly selected to answer the Guided Response Survey, and six students among the participants were purposively selected.

Instrumentation

The researcher made use of a Guided Response Survey Instrument distributed via Google Forms. The Guided Response Survey were validated by experts in the field using a validation matrix. The questionnaire is made up of Likert Scale. Students were asked about their experience of having a virtual laboratory. Moreover, focus interview questions were asked face-to-face. Sessions are recorded with the participant's consent. Students' academic performance in Science was collected and analyzed through statistical treatment.

Hypotheses of the Study

There is no significant difference in the learning achievement of the participants before and after the application of the intervention.

Statistical Analysis and Treatment of Data

The questionnaire data was coded, encoded, and statistically analyzed using the statistical software IBM-SPSS Statistics 23. The data was analyzed using various statistical tools such as frequency, percentage, weighted mean, and paired samples T-test.

Frequency or percentage distribution was used to display the students' learning achievement in their Science quarterly grade. The weighted mean determined the student's learning achievement and attitude. Likewise, it was applied to identify the students' evaluation of the Earth and Space Virtual Laboratory regarding Accessibility, content, and topic relevance.

Furthermore, the paired sample t-test was carried out to compare the students' learning achievement in terms of their Science Quarterly Grades before the second quarter and after the third quarter of the intervention's application.

In hypothesis testing, SPSS provides significance or probability values; thus, these are compared with the 0.05 level set in the study as the accepted significance level. If the significance or p-value is equal to or lower than 0.05, then the statistical value is significant; therefore, the null hypothesis is rejected.

For ease of interpretation, the following scales were used; Scale of Mean and Descriptive Equivalent of Survey Responses:

Scale of Means:	**Descriptive Equivalent**
5.00 – 4.21	Strongly Agree
4.20 – 3.41	Agree
3.40 – 2.61	Neutral
2.60 – 1.81	Disagree
1.80 – 1.00	Strongly Disagree

The scale of means is divided into five ranges, each with a corresponding descriptive equivalent. A score from 5.00 to 4.21 indicates "Strongly Agree," while 4.20 to 3.41 signifies "Agree." The range of 3.40 to 2.61 reflects a "Neutral" position, and 2.60 to 1.81 indicates "Disagree." Finally, scores from 1.80 to 1.00 represent "Strongly Disagree." This scale effectively captures the spectrum of respondents' attitudes toward a statement.

Descriptive Equivalent and Interpretation of Survey Responses:

Descriptive Equivalent	**Interpretation**
Strongly Agree	This is a total agreement with the statement without reservations.
Agree	This indicates a general agreement with the statement, but not fierily so.
Neutral	Neither agree nor disagree with the statement or unsure
Disagree	Generally disagree with the statement, though not vehemently.
Strongly Disagree	Vehemently disagree with the statement.

The descriptive equivalents provide concise interpretations of respondents' attitudes toward a statement. "Strongly Agree" indicates total agreement without reservations, while "Agree" reflects general agreement, albeit less emphatically. "Neutral" signifies neither agreement nor disagreement, or uncertainty about the statement. "Disagree" suggests a general disagreement that is not forceful, and "Strongly Disagree" represents a vehement rejection of the statement.

Scale of Means and Descriptive Equivalent of Quarterly Grades:

Scale of Means:	**Descriptive Equivalent**
100 – 90	Outstanding
89 – 85	Very Satisfactory
84 – 80	Satisfactory
79 – 75	Fairly Satisfactory
Below 75	Did Not Meet Expectations

The scale of means categorizes performance into five distinct levels. Scores between 100 and 90 are classified as "Outstanding," reflecting exceptional performance. Those scoring from 89 to 85 are labeled "Very Satisfactory," indicating a high level of achievement. A score within the range of 84 to 80 is deemed "Satisfactory," suggesting adequate performance. Scores from 79 to 75 fall under "Fairly Satisfactory," which indicates some shortcomings. Finally, any score below 75 is categorized as "Did Not Meet Expectations," highlighting the need for improvement. This framework provides a clear overview of performance levels.

Test of Normality

Table 2
Test of Normality

Quarters	**Kolmogorov-Smirnov**			**Shapiro-Wilk**		
	Statistic	***df***	***Sig.***	***Statistic***	***df***	***Sig.***
First Quarter	.086	75	.200	.968	75	.058
Second Quarter	.108	75	.032	.950	75	.025
Third Quarter	.115	75	.016	.961	75	.022
Fourth Quarter	.087	75	.200	.970	75	.070
Overall	**.083**	**75**	**.200**	**.969**	**75**	**.063**

Table 2 shows that the overall distribution of the differences between the students' Science Quarterly Grades was not significantly different from the normal distribution, as displayed by the overall significant values, which are greater than the .05 significant level. Thus, normality can be assumed for the overall students' Science Quarterly Grades.

Moreover, Thematic Analysis is used for the phenomenological qualitative design. It is a method for analyzing qualitative data that involves understanding through a set of information and observing patterns in the meaning of the data to find themes. It is a dynamic process of reflexivity in which the researcher's subjective involvement is at the center of making sense of the data. Thematic analysis is typical in qualitative research. It highlights identifying, analyzing, and interpreting qualitative data patterns. It is frequently used to describe a group of texts, like an interview or a set of transcripts. The researcher looks closely at the data to find common themes: repeated ideas, topics, or ways of putting things (Villegas, 2023).

The software used for the analysis is QDA Miner lite. Manual coding was employed. Transcripts were analyzed verbatim in Filipino. We completed a thematic three-phase analysis. Significant statements for coding were known, and multiple coding was also applied; this means that some selected statements were coded more than once.

In the first cycle of coding, 16 open codes were generated. Open descriptive English codes were used. In the second cycle analysis, codes were grouped into three categories: (1) learning achievement, (2) learning attitudes, and (3) app engagement. For the theme generation, codes were organized into five themes that would answer SOP 5. While Cycle 2 categorized the codes into three categories, it would be observed that the theme generation crosses these categories for meaningful theme generation (e.g., Theme 1 includes four codes of underachievement and one under attitude because the attitude provides a context for a deeper understanding of the theme). Further, take note that codes were used for multiple themes because their meaning cut across various themes (low interest in online learning in general and more active).

Results and Discussions

The results are divided into five parts. Part I displays the students' learning achievement and learning attitude. Part II describes the students' learning achievement regarding their quarterly science Grades. Part III shows the students' evaluation of the Earth and Space Virtual Laboratory regarding Accessibility, content, and topic relevance. Part IV reflects the comparison of the students' learning achievement in terms of Science Quarterly Grades before and after the application of the intervention. Part V presents changes in the students' learning attitude after the intervention.

Part I.
Learning Achievement and Learning Attitude Descriptions of Students.
It shows the results of the student's learning achievement and learning attitude descriptions, answering the first sub-problem. Eight tables present the results.

Table 1

Indicator	MEAN	SD	DE
1. I was able to compare ice extent on Arctic and Antarctic Sea Ice using the virtual laboratory.	4.05	0.84	Agree
2. I was able to observe phenomena that happens in real life through virtual laboratories.	4.13	0.68	Agree
3. I was able to analyze scenarios that are helpful to real life using virtual laboratories.	4.13	0.68	Agree
4. I was able to decide on energy choice in relation to climate change using a virtual laboratory.	4.16	0.64	Agree
5. I was able to finish my task on time with the help of the virtual laboratory.	4.21	0.76	Strongly Agree
6. I can classify different type of volcanoes easily with the help of virtual laboratory.	4.23	0.65	Strongly Agree
Composite	**4.15**	**0.51**	**Agree**

Science Skills of the Students

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; DE-Descriptive Equivalent

As depicted in Table 1, the indicator "I can classify different types of volcanoes easily with the help of virtual laboratory." accumulated the highest rating (Mean=4.23; SD=0.65; Strongly Agree), whereas the indicator "I was able to compare ice extent on Arctic and Antarctic Sea Ice using the virtual laboratory." obtained the lowest rating (Mean=4.05; SD=0.84; Agree).

In general, the students responded "Agree" on the statements of science skills, as indicated by the rating (Mean=4.15; SD=0.51). Students generally agree on having Science Skills (comparing, observing, analyzing, decision-making, time managing, and classifying) but not fierily so.

Table 2
Science Understanding of the Students

Indicator	MEAN	SD	DE
1. I got higher scores on written works with the help of virtual laboratory.	4.03	0.77	Agree
2. I got better results on my performance tasks with the help of virtual laboratory.	4.05	0.77	Agree
3. I unlocked more scientific ideas by learning through virtual laboratory.	4.07	0.79	Agree
4. I can share to my classmates the information I learned, as I understand the lesson well through the virtual laboratory.	4.12	0.68	Agree
5. I can apply what I learn through virtual laboratories on important situations, like the precautions for volcanic eruptions, saving energy at home etc.	4.24	0.80	Strongly Agree
6. I can comprehend information easier with the help of virtual laboratory.	4.25	0.66	Strongly Agree
Composite	**4.13**	**0.57**	**Agree**

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; DE-Descriptive Equivalent

As reflected in Table 2, the indicator with the highest rating (Mean=4.25; SD=0.66; Strongly Agree) is "I can comprehend information easier with the help of virtual laboratory." and the indicator with the lowest rating (Mean=4.03; SD=0.77; Agree) is "I got higher scores on written works with the help of virtual laboratory."

In total, the rating (Mean=4.13; SD=0.57) signifies that the students responded "Agree" on the statements of science understanding to the extent that they got better performance and understanding.

Table 3
Students' Attitude to Learn Science

Indicator	MEAN	SD	DE
1. Learning science through virtual laboratory motivates me to get high scores and grades in Earth and Space.	4.03	0.75	Agree
2. I am excited to see the next virtual laboratory on our class.	4.09	0.82	Agree
3. Learnings Science through virtual laboratory made me appreciate Earth more and its capability to sustain life.	4.09	0.68	Agree
4. I like it more to learn science with a virtual laboratory.	4.11	0.78	Agree
5. I get to love learning Earth and Space with the help of the virtual laboratory.	4.19	0.67	Agree
6. I get more curious on how special the Planet Earth is.	4.24	0.69	Strongly Agree
Composite	**4.12**	**0.59**	**Agree**

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; DE-Descriptive Equivalent

As presented in Table 3, the indicator with the highest rating (Mean=4.24; SD=0.69; Strongly Agree) is "I am more curious about how special the Planet Earth is." Meanwhile, the indicator with the lowest rating (Mean=4.03; SD=0.75; Agree) is "Learning science through virtual laboratory motivates me to get high scores and grades in Earth and Space."

The students responded "Agree" on the statements of student attitude to learning Science, as described by the rating (Mean=4.12; SD=0.59).

Table 4
Students' Participation

Indicator	MEAN	SD	DE
Recitation	3.73	0.64	Agree
Task Submissions	4.21	0.64	Strongly Agree
Composite	**3.97**	**0.57**	**Agree**

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; DE-Descriptive Equivalent

Table 4 illustrates that among the two (2) indicators of Student Participation, the indicator “Task Submissions" has a higher rating (Mean=4.21; SD=0.64; Strongly Agree) than the indicator “Recitation” (Mean=3.73; SD=0.64; Agree).

Taken collectively, the rating (Mean=3.97; SD=0.57) recommends that the students respond "Agree” on the statements of student participation. Students agree getting better on recitation and task submission.

Table 5
Students' Learning Attitude in Recitation

Indicator	MEAN	SD	DE
1. I raised questions that builds up while doing virtual laboratory to help me more understand the lesson.	3.53	0.83	Agree
2. I was able to volunteer on explaining parts of what is presented on the virtual laboratory.	3.59	0.82	Agree
3. I was able to raise my hand during recitation as I gain more confidence on what I learn.	3.71	0.87	Agree
4. I was able to easily share my ideas on what I observed during a virtual laboratory.	3.71	0.83	Agree
5. I can correctly answer questions asked by the teacher.	3.89	0.75	Agree
6. I can perform well the virtual laboratories given.	3.97	0.79	Agree
Composite	**3.73**	**0.64**	**Agree**

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; DE-Descriptive Equivalent

As shown in Table 5 the indicator that gained the highest rating (Mean=3.97; SD=0.79; Agree) is "I can perform well in the virtual laboratories given." whereas the indicator that earned the lowest rating (Mean=3.53; SD=0.83, Agree) is "I raised questions that build up while doing virtual laboratory to help me more understand the lesson.”

The rating (Mean=3.73; SD=0.64) suggests that the students responded “Agree” on the statements about their participation, specifically in recitation.

Table 6
Students' Learning Attitude in Task Submissions

Indicator	MEAN	SD	DE
1. I always allocate time to do the task given.	4.11	0.75	Agree
2. I am motivated to get high scores on the tasks given.	4.12	0.85	Agree
3. I am interested to accomplish the tasks given.	4.21	0.70	Strongly Agree
4. I make sure to review my answers before the submission.	4.24	0.79	Strongly Agree
5. I make sure to do and submit the task on time.	4.25	0.82	Strongly Agree
6. I take it seriously while answering/doing the task.	4.31	0.75	Strongly Agree
Composite	**4.21**	**0.64**	**Strongly Agree**

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; DE-Descriptive Equivalent

As reflected in Table 6, the indicator "I take it seriously while answering/doing the task." acquired the highest rating (Mean=4.31; SD=0.75; Strongly Agree), and the indicator "I always allocate time to do the task given." got the lowest rating (Mean=4.11; SD=0.75; Agree).

Generally, the students responded "Strongly Agree" on the statements of students' participation, specifically in task submissions, as displayed by the rating (Mean=4.21; SD=0.64).

Table 7
Students' Learning Achievement

Indicator	MEAN	SD	DE
Science Understanding	4.13	0.57	Agree
Science Skills	4.15	0.51	Agree
Composite	**4.14**	**0.49**	**Agree**

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; **DE**-Descriptive Equivalent

Table 7 portrays that among the two (2) indicators of Learning Achievement, the indicator "Science Skills" has a higher rating (Mean=4.15; SD=0.51; Agree) than the indicator "Science Understanding" (Mean=4.13; SD=0.57; Agree).

Overall, the students responded "Agree" on the student's learning achievement, having better Science Skills and S, as denoted by the rating (Mean=4.14; SD=0.49).

Table 8
Students' Learning Attitude

Indicator	MEAN	SD	DE
Student Participation	3.97	0.57	Agree
Student Attitude to learn Science	4.12	0.59	Agree
Composite	**4.05**	**0.53**	**Agree**

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; **DE**-Descriptive Equivalent

"Student Attitude to learn Science" has the higher rating *(Mean=4.12; SD=0.59; Agree)* in contrast with the indicator "Student Participation" *(Mean=3.97; SD=0.57; Agree)*.

The rating *(Mean=4.05; SD=0.53)* indicates that the students responded "*Agree*" to the statements about their learning attitude. Students agree that they have positively improve their participation and attitude to learn Science.

Generally speaking, learning attitude determines how an individual perceives and processes a thing and how it shapes one's thoughts, ideas, decisions, and life's course. The majority of the learning attitude is built in schools through formal education. However, attending school is just one of the many ways to learn. Learning attitude may happen in every environment we are in (Colhando, S. 2020).

Part II.
Learning Achievement on the Quarterly Science Grades of Students.
It describes the students' learning achievement regarding their quarterly science Grades. It was considered to compare the difference in students' performance before, during, and after the application of the intervention.

Table 9
Students' Science First Quarter Grades

Grading Scale	Descriptive Equivalent	Frequency	Percentage	Overall Mean
90 – 100	Outstanding	29	39	**87.56**
85 – 89	Very Satisfactory	25	34	***(SD=5.50)***
80 – 84	Satisfactory	13	17	*Very Satisfactory*
75 – 79	Fairly Satisfactory	7	9	
Below 75	Did Not Meet Expectations	1	1	
Total		**75**	**100**	

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; **DE**-Descriptive Equivalent

As seen in Table 9, the descriptive equivalent "Outstanding," on a grading scale of 90 to 100, accumulated the highest percentage of thirty-nine percent (39%), while the descriptive equivalent "Did Not Meet Expectations," on a grading scale of below 75, obtained the lowest percentage of only one percent (1%).

Generally, the rating (Mean=87.56; SD=5.50) signifies that the students' Science First Quarter Grades are "Very Satisfactory."

Table 10
Students' Science Second Quarter Grades

Grading Scale	Descriptive Equivalent	Frequency	Percentage	Overall Mean
90 – 100	Outstanding	27	36	**85.44**
85 – 89	Very Satisfactory	19	26	***(SD=7.01)***
80 – 84	Satisfactory	10	13	*Very Satisfactory*
75 – 79	Fairly Satisfactory	10	13	
Below 75	Did Not Meet Expectations	9	12	
Total		**75**	**100**	

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; **DE**-Descriptive Equivalent

Table 10 shows that the descriptive equivalent with the highest percentage of thirty-six percent (36%) is "Outstanding," a grading scale of 90 to 100. In contrast, the descriptive equivalent with the lowest percentage of twelve percent (12%) is "Did Not Meet Expectations," a grading scale below 75.

In total, the students' Science Second Quarter Grades are "Very Satisfactory," as denoted by the rating (Mean=85.44; SD=7.01).

Table 11
Students' Science Third Quarter Grades

Grading Scale	Descriptive Equivalent	Frequency	Percentage	Overall Mean
90 – 100	Outstanding	35	47	**87.71**
85 – 89	Very Satisfactory	19	25	***(SD=6.02)***
80 – 84	Satisfactory	12	16	*Very*
75 – 79	Fairly Satisfactory	6	8	*Satisfactory*
Below 75	Did Not Meet Expectations	3	4	
Total		**75**	**100**	

DEPED Order No. 8, S. 2015: Learners Progress and Achievement Descriptors

As revealed in Table 11, the descriptive equivalent "Outstanding," on a grading scale of 90 to 100, attained the highest percentage of forty-seven percent (47%). In contrast, the descriptive

equivalent "Did Not Meet Expectations," on a grading scale of below 75, got the lowest percentage of four percent (4%).

The rating (Mean=87.71; SD=6.02) proposes that the students' Science Third Quarter Grades are "Very Satisfactory."

Table 12
Students' Science Fourth Quarter Grades

Grading Scale	Descriptive Equivalent	Frequency	Percentage	Overall Mean
90 – 100	Outstanding	20	27	**84.79**
85 – 89	Very Satisfactory	21	28	***(SD=6.50)***
80 – 84	Satisfactory	20	27	*Satisfactory*
75 – 79	Fairly Satisfactory	8	10	
Below 75	Did Not Meet Expectations	6	8	
Total		**75**	**100**	

DEPED Order No. 8, S. 2015: Learners Progress and Achievement Descriptors

As reflected in Table 12, the descriptive equivalent with the highest twenty-eight percent (28%) is "Very Satisfactory," a grading scale of 85 to 89. In contrast, the descriptive equivalent with the lowest percentage of eight percent (8%) is "Did Not Meet Expectations," a grading scale below 75.

The students' Science Fourth Quarter Grades are "Satisfactory," as marked by the rating (Mean=84.79; SD=6.50).

Part III.
Evaluation of Students on Accessibility, Content, and Topic Relevance of Earth and Space Virtual Laboratory.
It shows the students' evaluation of the Earth and Space Virtual Laboratory regarding Accessibility, content, and topic relevance. These are all critical factors to consider while using the intervention.

Table 13
Students' Evaluation of Virtual Laboratory's Accessibility

Indicator	MEAN	SD	DE
1. I can access Virtual Laboratory just by using a mobile data.	3.87	0.91	Agree
2. I can easily access Virtual Laboratories.	4.04	0.80	Agree
3. I didn't have a hard time accessing virtual laboratories.	4.07	0.84	Agree
4. It is not required to have latest gadgets just to use virtual laboratory.	4.16	0.79	Agree
5. Virtual Laboratories are available any time of the day.	4.28	0.71	Strongly Agree
6. I can access virtual laboratories for free.	4.36	0.67	Strongly Agree
Composite	**4.13**	**0.64**	**Agree**

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; **DE**-Descriptive Equivalent

As revealed in Table 13, the indicator "I can access virtual laboratories for free" obtained the highest rating *(Mean=4.36; SD=0.67; strongly agree)*, whereas the indicator "I can access Virtual Laboratory just by using mobile data" got the lowest rating *(Mean=3.87; SD=0.91; agree)*.

Generally, the students responded "*Agree*" on evaluating the Virtual Laboratory's Accessibility, as noted by the rating *(Mean=4.13; SD=0.64)*.

Table 14

Students' Evaluation of Virtual Laboratory's Content

Indicator	MEAN	SD	DE
1. It shows content that only virtual laboratories can, like the use of video clips.	4.16	0.74	Agree
2. Instructions are easy to understand and appropriate for me as a learner.	4.21	0.76	Strongly Agree
3. The selected Virtual Laboratory shows the main idea of the Earth and Space Lessons.	4.27	0.64	Strongly Agree
4. Contents of the Virtual Laboratory help me to enhance my understanding on the lessons.	4.27	0.62	Strongly Agree
5. Virtual Laboratory helps me understand more about Earth and Space.	4.31	0.66	Strongly Agree
6. Virtual Laboratory contents are informative.	4.41	0.64	Strongly Agree
Composite	**4.27**	**0.54**	**Strongly Agree**

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree

SD-Standard Deviation; DE-Descriptive Equivalent

As presented in Table 14, the indicator with the highest rating (Mean=4.41; SD=0.64; Strongly Agree) is "Virtual Laboratory contents are informative." and the indicator with the lowest rating (Mean=4.16; SD=0.74; Agree) is "It shows content that only virtual laboratories can, like the use of video clips."

The rating (Mean=4.27; SD=0.54) implies that the students responded "Strongly Agree" on evaluating the Virtual Laboratory's content.

Table15

Students' Evaluation of Virtual Laboratory's Topic Relevance

Indicator	MEAN	SD	DE
1. UCAR is very useful for the discussion of climate change.	4.15	0.63	Agree
2. Phet Simulations is useful for the greenhouse effect discussion.	4.15	0.67	Agree
3. Volcanoes from Mheducation website is applicable on the first topic which is about volcanoes.	4.24	0.65	Strongly Agree
4. All topics were easier to understand with the help of the virtual laboratories.	4.28	0.75	Strongly Agree
5. Solarsystemscope is appropriate for the stars and constellation part.	4.32	0.66	Strongly Agree
6. All Virtual Laboratory Activities used were relevant to the topic discussed.	4.41	0.57	Strongly Agree
Composite	**4.26**	**0.56**	**Strongly Agree**

Strongly Disagree

SD-Standard Deviation; **DE**-Descriptive Equivalent

As presented in Table 15, the indicator that earned the highest rating is "All Virtual Laboratory Activities used were relevant to the topic discussed." (Mean=4.41; SD=0.57; Strongly Agree), while the indicators that have the lowest ratings are "UCAR is very useful for the discussion of climate change."(Mean=4.15; SD=0.63; Agree) and "Phet Simulations is useful for the greenhouse effect discussion" (Mean=4.15; SD=0.67; Agree).

The students responded "Strongly Agree" on evaluating the Virtual Laboratory's topic relevance, as indicated by the rating (Mean=4.26; SD=0.56).

Table 16
Students' Evaluation on the Earth and Space Virtual Laboratory

Indicator	MEAN	SD	DE
Accessibility	4.13	0.64	Agree
Topic Relevance	4.26	0.56	Strongly Agree
Content	4.27	0.54	Strongly Agree
Composite	**4.22**	**0.52**	**Strongly Agree**

Scale of Means: 5.00–4.21 Strongly Agree; 4.20–3.41 Agree; 3.40–2.61 Neutral; 2.60–1.81 Disagree; 1.80–1.00 Strongly Disagree
SD-Standard Deviation; DE-Descriptive Equivalent

Table 16 portrays that among all indicators of the students' Evaluation of the Earth and Space Virtual Laboratory, the indicator "Content" has the highest rating (Mean=4.27; SD=0.54; Strongly Agree), followed by "Topic Relevance" (Mean=4.26; SD=0.56; Strongly Agree), and the lowest rating is "Accessibility" (Mean=4.13; SD=0.64; Agree).
In summary, the rating (Mean=4.22; SD=0.52) recommends that the students respond "Strongly Agree" on the Earth and Space Virtual Laboratory evaluation statements.

Part IV.
It reflects the comparison of the students' learning achievement in terms of their Science Quarterly Grades before and after the application of the intervention. Comparing the result to other quarters helps evaluate the result of the intervention.

Table 17
Comparison of the Science Quarterly Grades before and after the Intervention.

Quarter	N	Mean	*Sd*	*t-value (74)*	*p-value*	*Remarks*
Second Quarter *(before)*	75	85.44	7.01	-4.83 **	.000	Reject the Null
Third Quarter *(after)*	75	87.71	6.02			

*significant at 0.01 alpha level

As seen in Table 17, there is sufficient evidence that a significant difference exists in the students' quarterly science grades, specifically for the Second and Third Quarters, as displayed by the test statistic value [t (74) =-4.83; sig=.000]. It suggests that the students' Third-Quarter Grades (Mean=87.71; SD=6.02) are significantly higher than their Second-Quarter Grades (Mean=85.44; SD=7.01).

Part V.

Perceived Changes in the Learning Attitude of Students After the Intervention

It presents perceived changes in the student's learning attitude after the intervention. The following themes were coded from the answers to students' interviews. A thematic three-phase analysis was performed, and significant statements for coding were identified. In the first cycle of coding, 16 open codes were generated. In the second cycle analysis, codes were grouped into three categories: (1) learning achievement, (2) learning attitudes, and (3) app engagement.

. For the theme generation, codes were organized into five themes that would answer SOP 5. While Cycle 2 categorized the codes into three categories, it would be observed that the theme generation crosses these categories for meaningful theme generation. Further, take note that codes were used for multiple themes because their meaning cut across various themes.

Theme 1: Supports student achievement amid low motivation in OL. Most students believe that the intervention helped them understand the lesson better. It is beneficial in OL because students expressed low motivation for learning through OL. This low motivation is expressed under challenging topics (since science is now offered in spiral progression in contrast to the prior curriculum). However, the intervention helps students have a better and deeper understanding of the topics by activating student interest through VL.

Theme 2: Conscious application of science skills. Students consciously apply science skills in learning, such as observation, analysis, and decision-making. The intervention helps by giving them opportunities to apply them in active learning.

Theme 3: More focused learning. As indicated in Theme 1, students tend to have low motivation in OL. However, the interactive nature of the intervention challenges them to be moved, involved, and active. Hence, they tend to be more focused, unlike their usual distracted self in OL.

Theme 4: Improved student confidence. Students experience waning and waxing confidence and interest in Science, which could be due to the spiral nature of the curriculum. Some participants expressed difficulty in the subject, with a few exceptions in exciting topics. Using VL enabled the students to understand the topic more efficiently, which helped them gain better confidence to participate actively. Hence, being "more active" here is the result of improved confidence in their understanding of the lesson, while being "more active" (due to the interactive nature of the app) in the previous theme is a means to help students improve their attention span.

Theme 5: Enjoyable learning. Students generally found learning more enjoyable when the teacher used the VL. It piqued their natural curiosity and interest. This personal interest, along with the informative and user-friendly design of the app, enabled participants to make the best of available information about chosen topics.

Conclusion And Recommendation

There is a significant difference in the learning achievement of the participants before and after the application of the intervention.

The results and findings reveal that virtual laboratories positively affect students' learning achievement and learning attitude while learning online.

The following recommendations are given to those the researchers believed would benefit greatly from this study. The participants' experiences, which were analyzed and presented, will benefit other individuals.

1.Since the researcher found the positive effects of the Virtual Laboratory among the students and helped increase their performance, it is highly recommended that the Institution consider the development of a program or center that will concentrate more on the creation of the Virtual Laboratory. Developing programs and animations will help the institution to improve the learning experience of the students with consideration of the Institution's resources. Also, it can open new opportunities for the school to offer it to other institutions as well.

2.The positive result of the study encourages educators to integrate Virtual Laboratories in teaching Earth, space, and other sciences. This will improve students' skills and develop creative and critical thinking.

3. The application used for virtual laboratories demands student gadgets and connectivity. Future users of Virtual laboratories must consider the gadgets used by the learners and their connectivity capabilities. Also, teachers should be resourceful enough to look for virtual laboratories that can be accessible for all the students. On the other hand, partnerships with technology providers or low-bandwidth solutions may be considered.

4.The study revealed perceived changes that the students are suggested to understand so that they can be more conscious of the application of their science skills, more focused on learning, improve their confidence, and enjoy the learning process. They may also see and become aware of the common learning skills and attitudes they need to enhance.

5.Teachers are also recommended to actively participate in and attend free seminars/webinars from different organizations. These could extend their knowledge of using the virtual laboratory and enhance their skills and abilities when working within their job function.

6.Future researchers are recommended to use the findings from this study as a reference for future related research. They may use the same statement of the problem with different participants, research locale, or other modifications. They may also conduct the same study using different research methods that they may find more accurate than the methods used in this study.

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